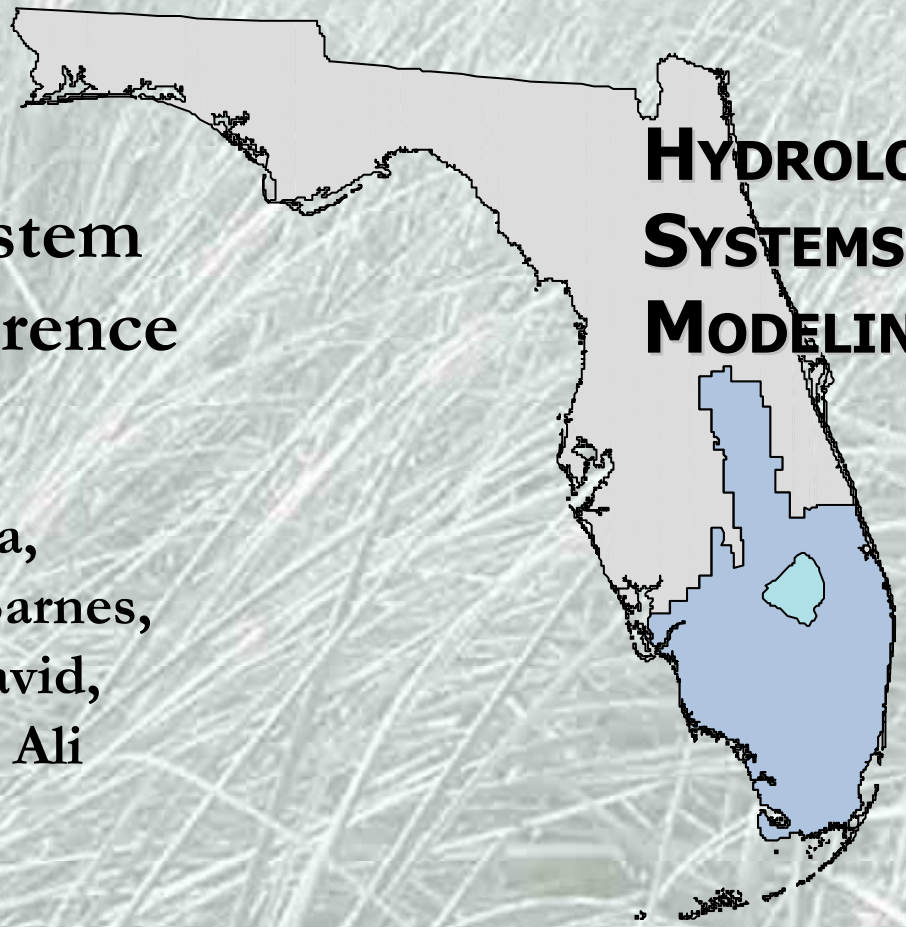
Sensitivity of the Comprehensive Everglades Restoration Plan to Individual Project Components

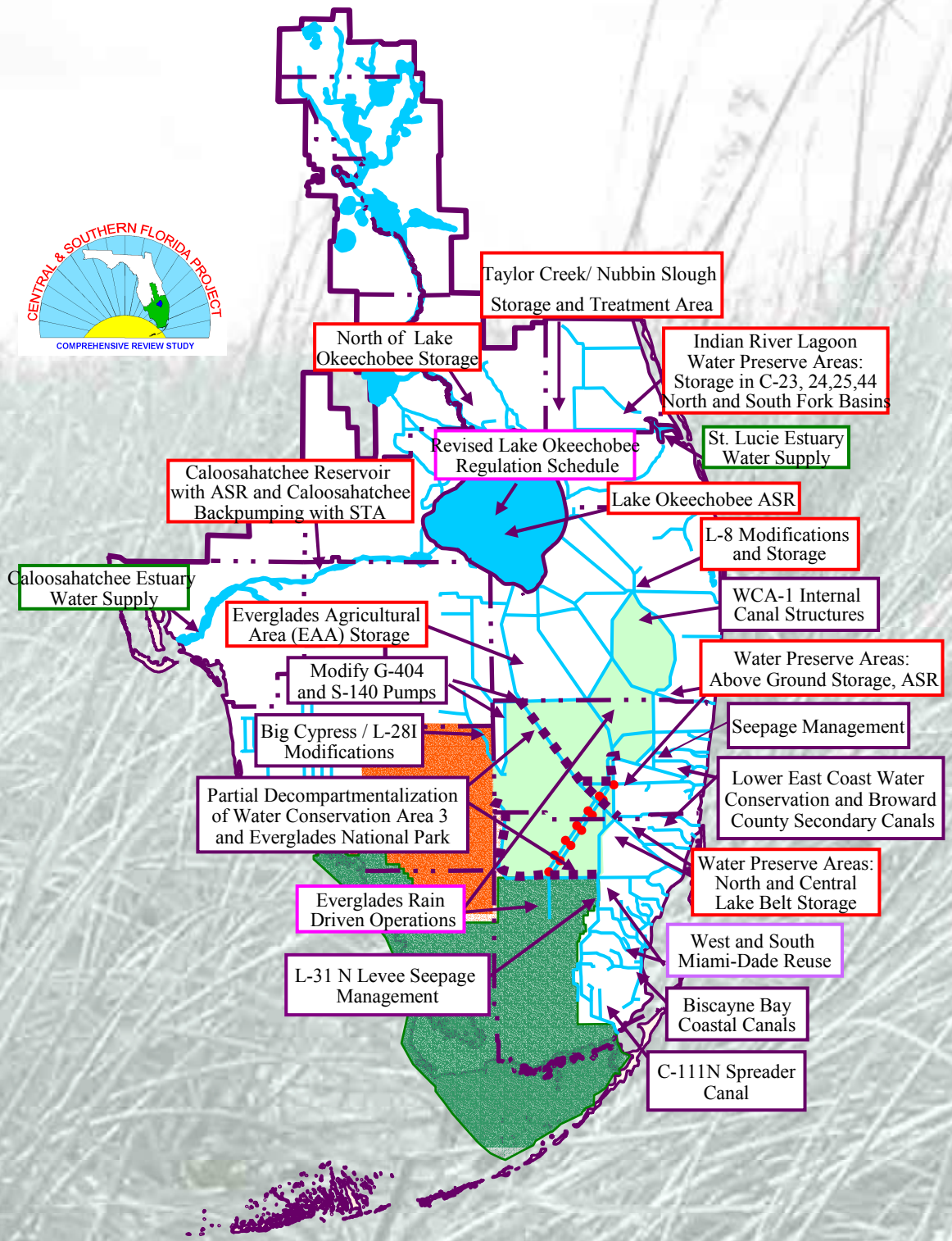


HYDROLOGIC SYSTEMS MODELING

Greater Everglades Ecosystem Restoration Science Conference

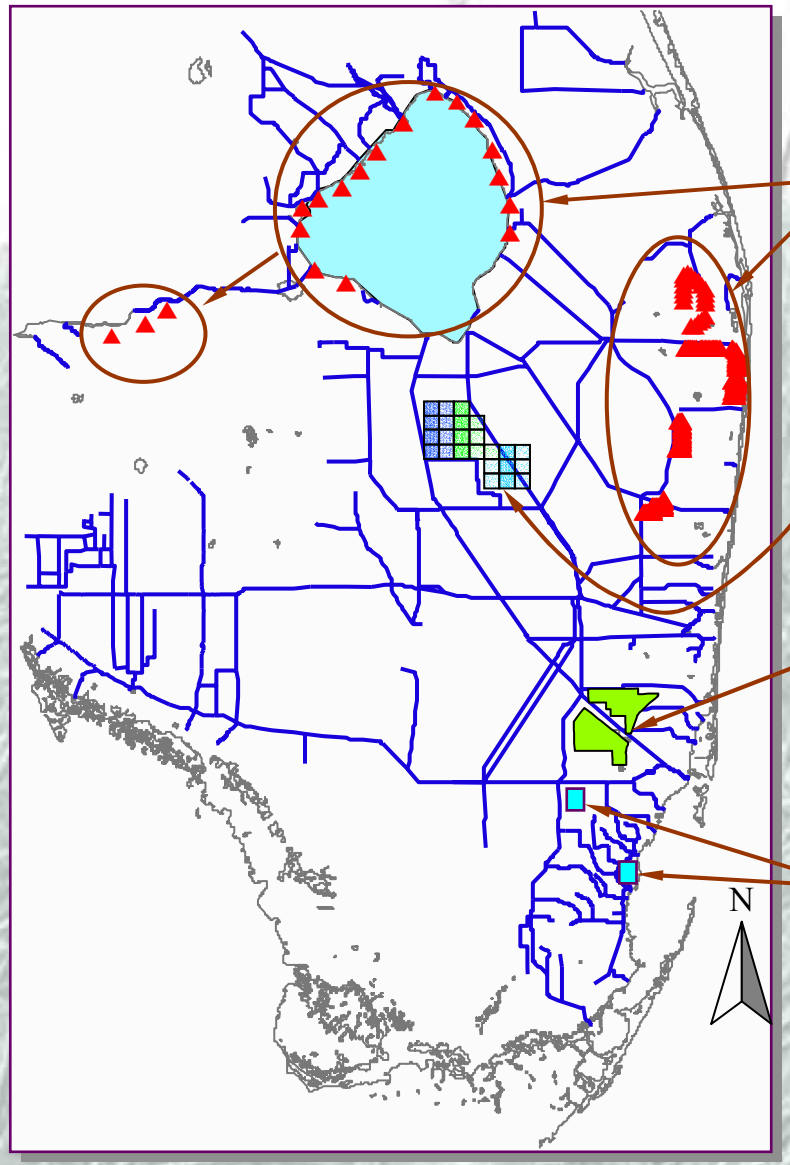
By: Everett R. Santee, Raul Novoa, Ken C. Tarboton, Jenifer A. Barnes, Lehar M. Brion, Luis G. Cadavid, Calvin J. Neidrauer, and Alaa Ali

Comprehensive Everglades Restoration Plan Components



- Storage/STA/ASR
- Canals/Structure modifications
- Operational
- Decompartmentalization
- Estuary water supply
- Reuse
- Seepage Management

CERP Components In Sensitivity Study

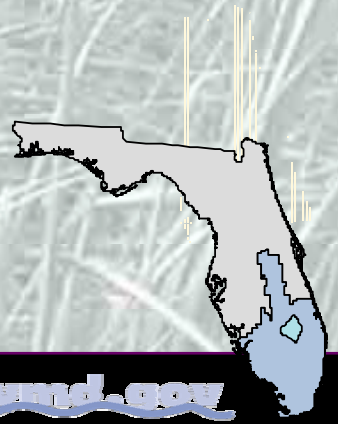


Aquifer Storage and Recovery

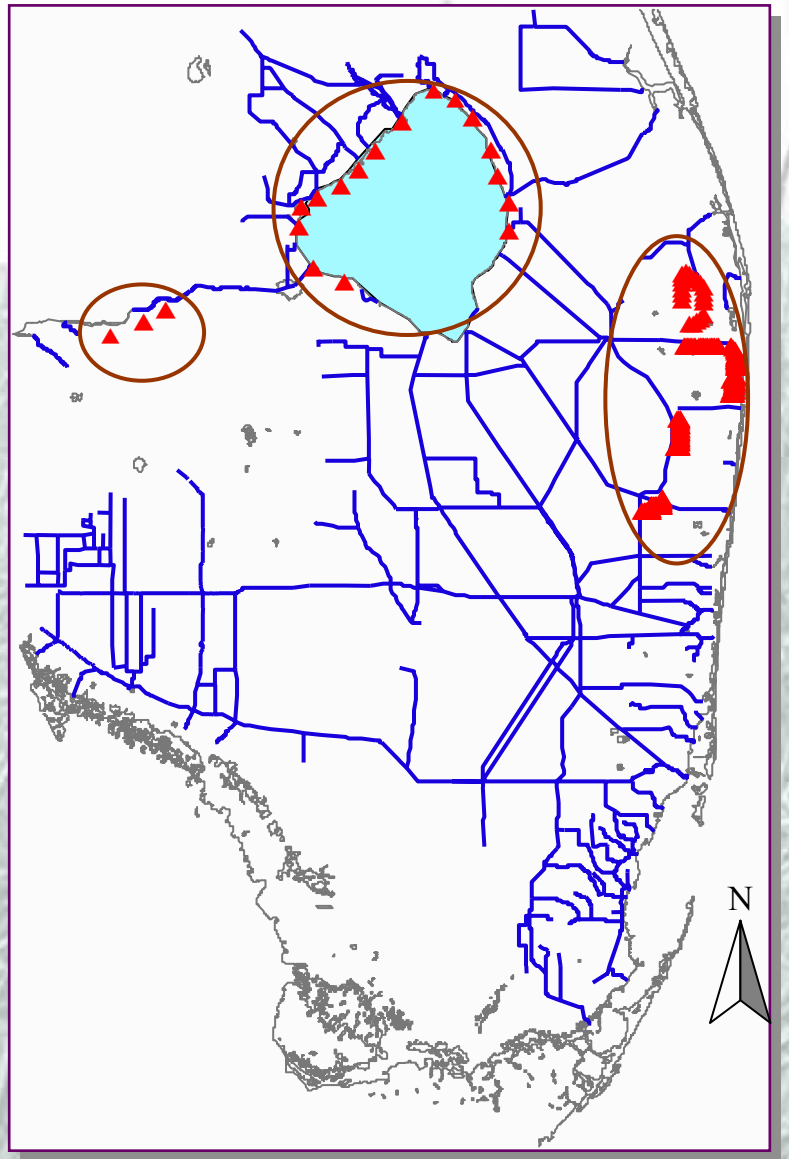
Everglades Agricultural Area Reservoirs

Lake Belt Storage

Miami-Dade County Reuse



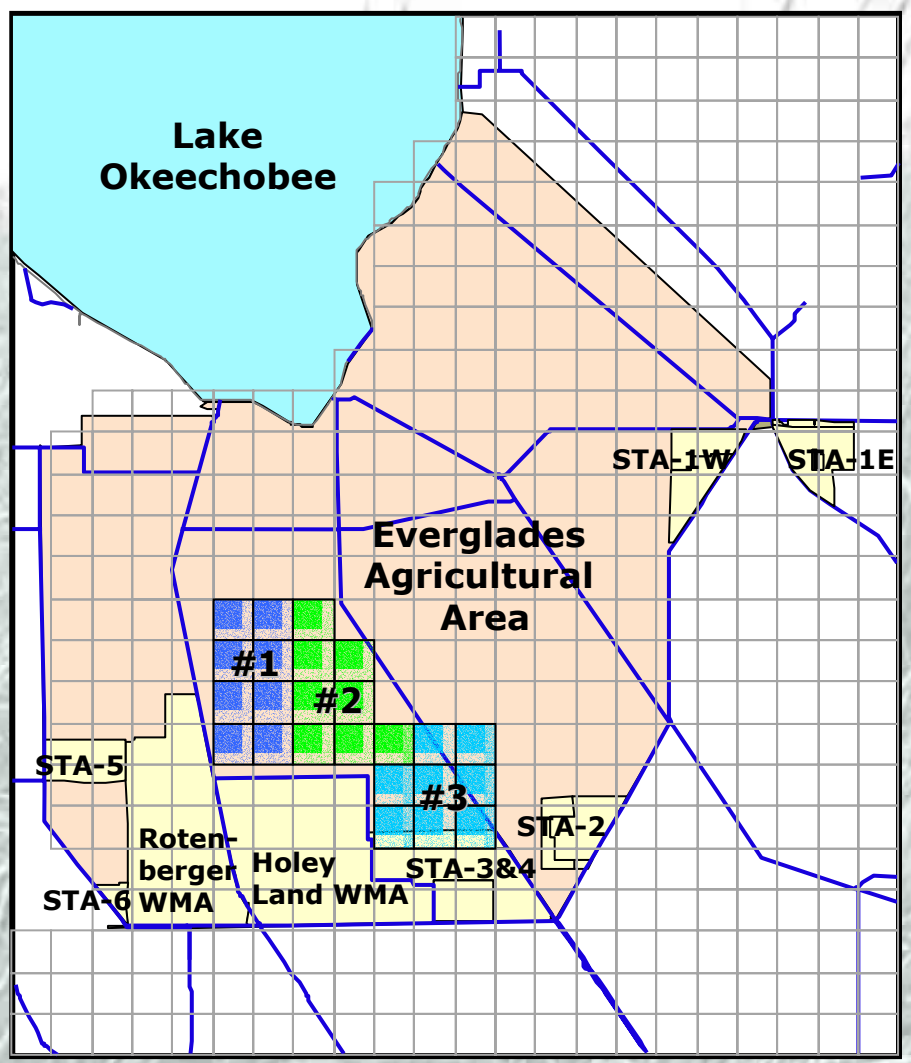
CERP Components In Sensitivity Study



Aquifer Storage and Recovery (1665 MGD)

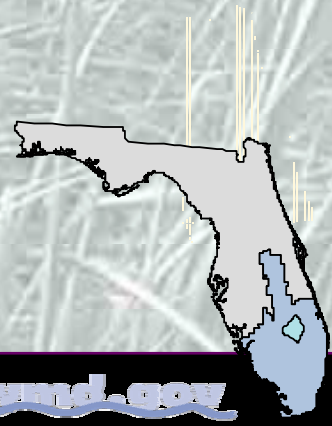
- **Caloosahatchee River Basin ASR (220 MGD)**
- **Lake Okeechobee ASR (1000 MGD)**
- **Lower East Coast Region ASR (445 MGD)**
  - C-51 Regional Groundwater ASR (170 MGD)
  - West Palm Beach Water Catchment Area ASR (50 MGD)
  - Palm Beach County Agricultural Reserve ASR (75 MGD)
  - Hillsboro Site 1 ASR (150 MGD)

CERP Components In Sensitivity Study



Everglades Agricultural Area Storage Reservoirs (360,000 ac-ft)

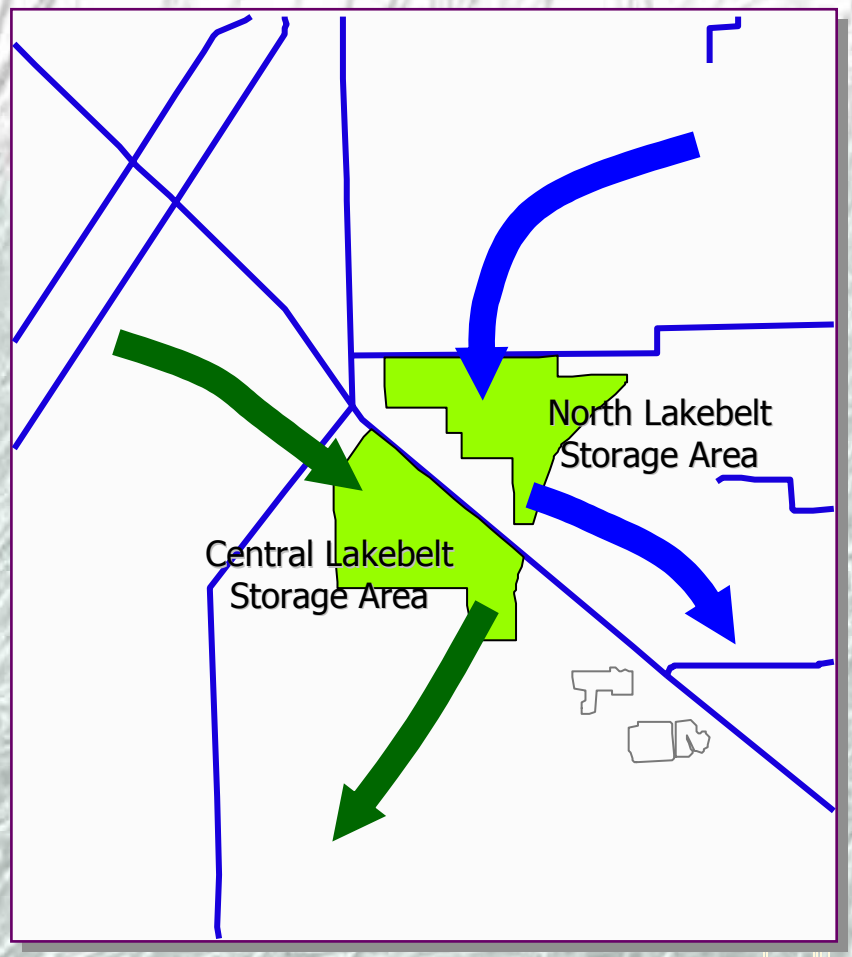
- **Compartment #1 (120,000 ac-ft)**
  - used to meet Everglades Agricultural Area irrigation demands
- **Compartments #2&3 (each 120,000 ac-ft)**
  - used to meet environmental demands as a priority

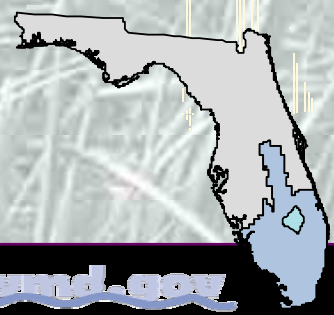


CERP Components In Sensitivity Study

Lake Belt Storage Areas

- **North Lake Belt Storage Area (90,000 ac-ft)**
  - to capture stormwater runoff
  - to maintain canal stages and provide water deliveries to Biscayne Bay
- **Central Lake Belt Storage Area (190,000 ac-ft)**
  - to store excess water from Water Conservation Areas 2 and 3
  - to provide environmental water supply deliveries to Northeast Shark River Slough and Water Conservation Area 3B

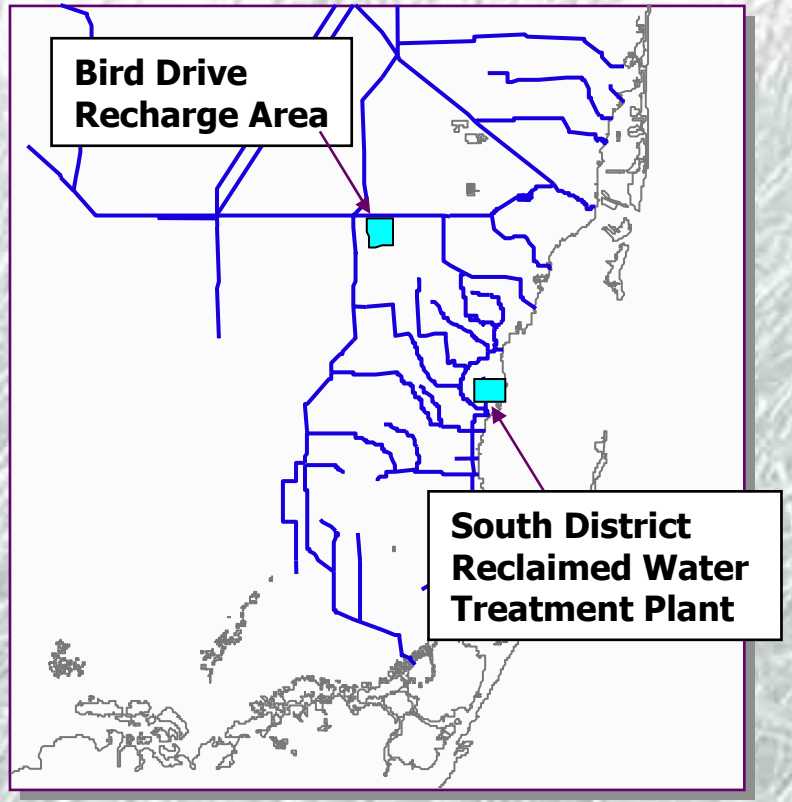


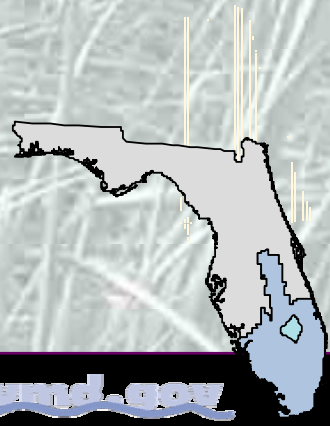


CERP Components In Sensitivity Study

Dade County Re-Use Water

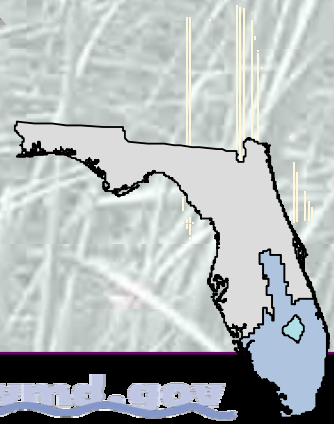
- **West Miami-Dade-County Re-Use Water (100 MGD)**
  - south of the Bird Drive Recharge Area
  - to enhance groundwater recharge to the Bird Drive Recharge Area, and to provide water supplies to the South Dade Conveyance System
- **South Miami-Dade County Re-Use Water (131 MGD)**
  - to augment water supply to the South Biscayne Bay and Coastal Wetlands, and to recharge groundwater and provide saltwater intrusion benefits



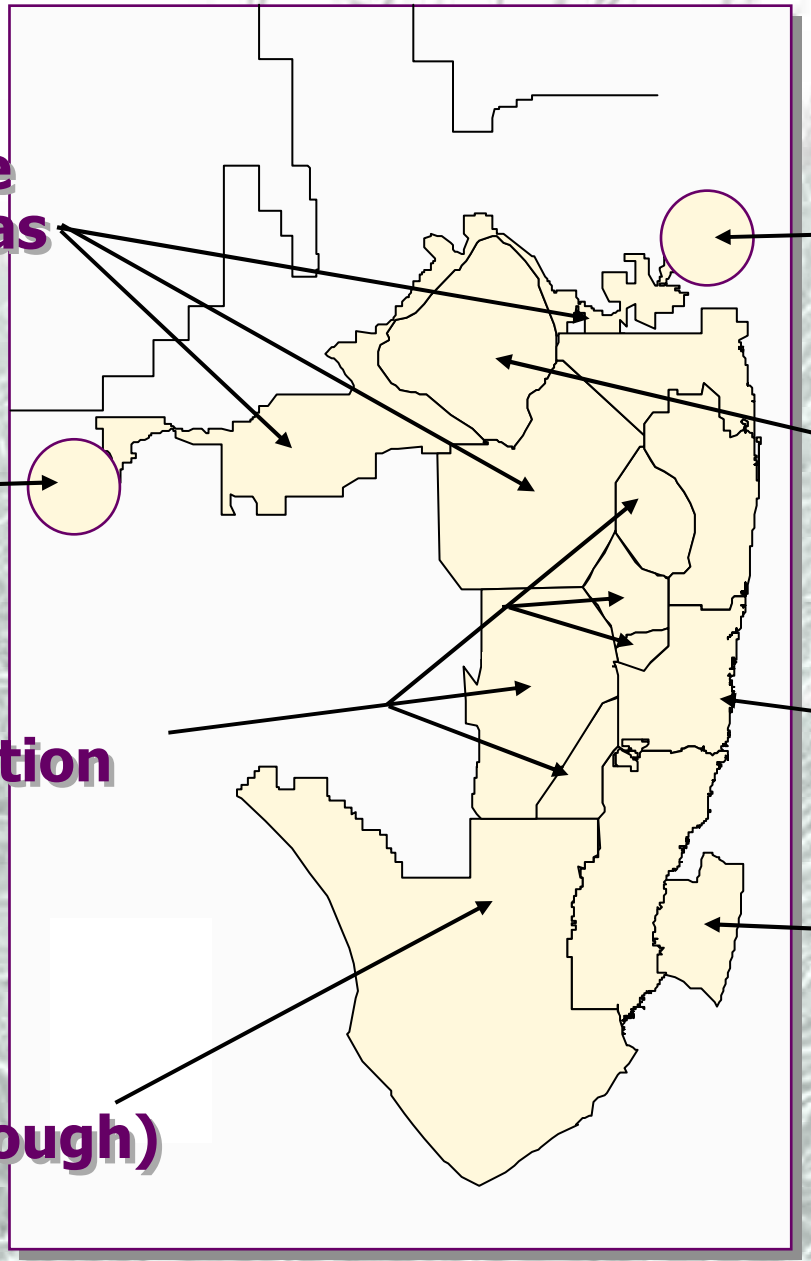


Modeling Assumptions

- **Use of the South Florida Water Management Model v3.5**
  - → 31 year continuous simulation (1965-1995)
- **No operational adjustments or physical components were added or substituted to compensate for the elimination of any of the CERP components**
- **All output comparisons are made relative to D13R**



Areas of Interest In Sensitivity Study



Lake Okeechobee Service Areas

St. Lucie Estuary

Caloosahatchee Estuary

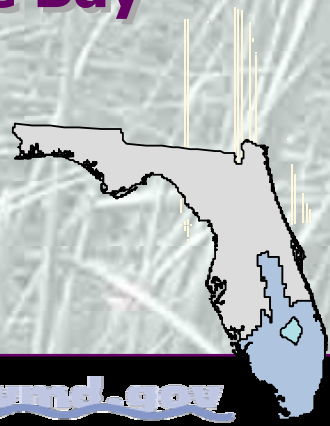
Lake Okeechobee

Water Conservation Areas

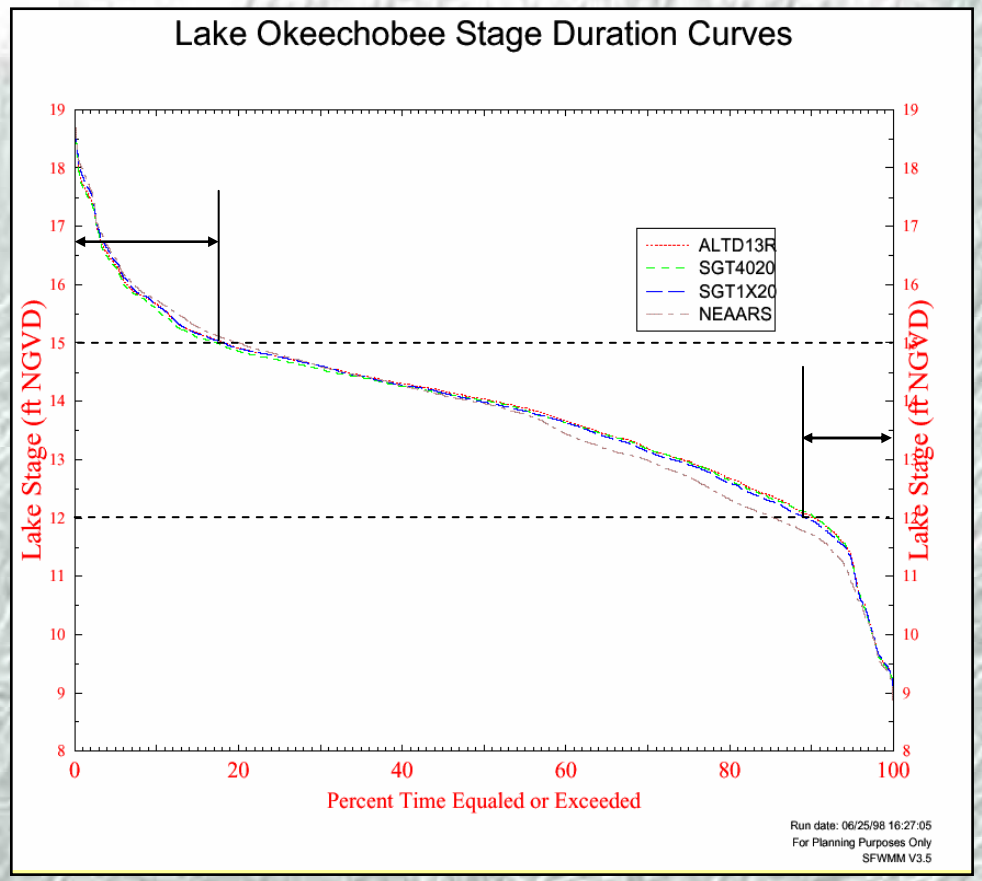
Lower East Coast

Biscayne Bay

Everglades National Park (Shark River Slough)



Hydrologic Performance Indicators



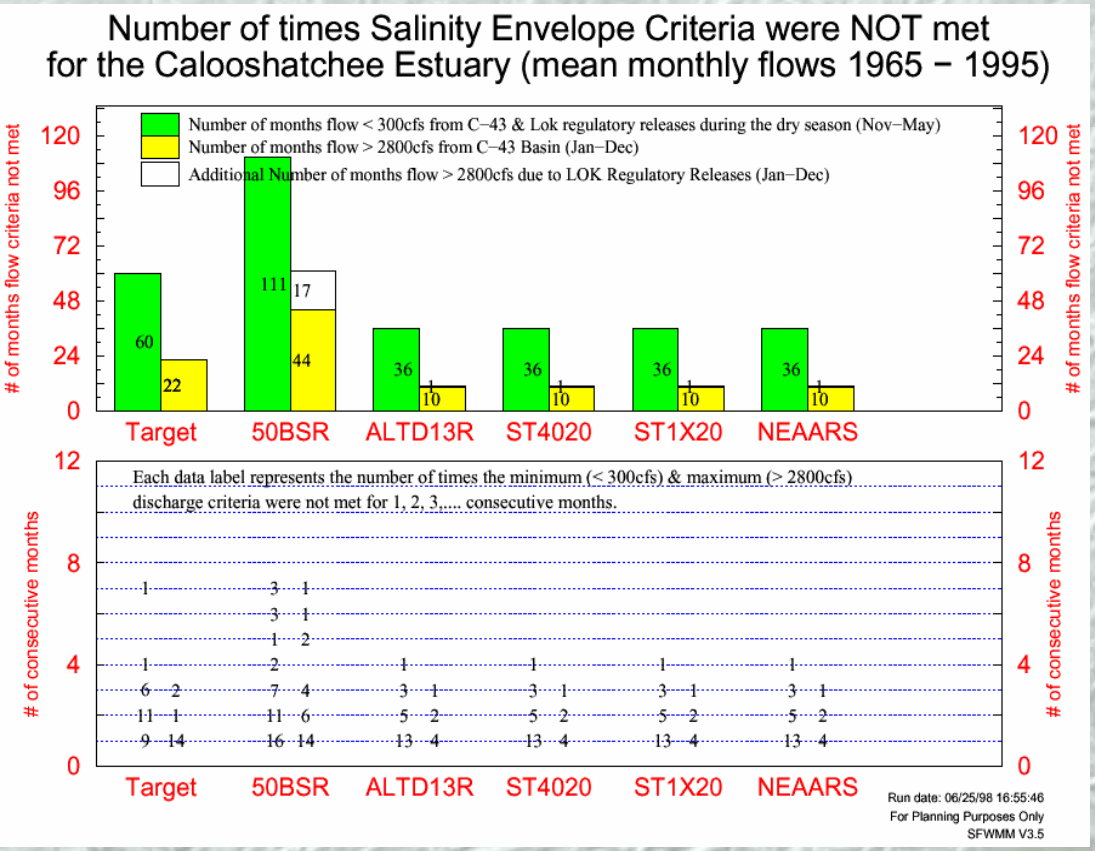
Lake Okeechobee

- **Percent of Time Lake Stage is Below 12 ft**
- **Percent of Time Lake Stage is Above 15 ft**

Hydrologic Performance Indicators

St. Lucie & Caloosahatchee Estuaries

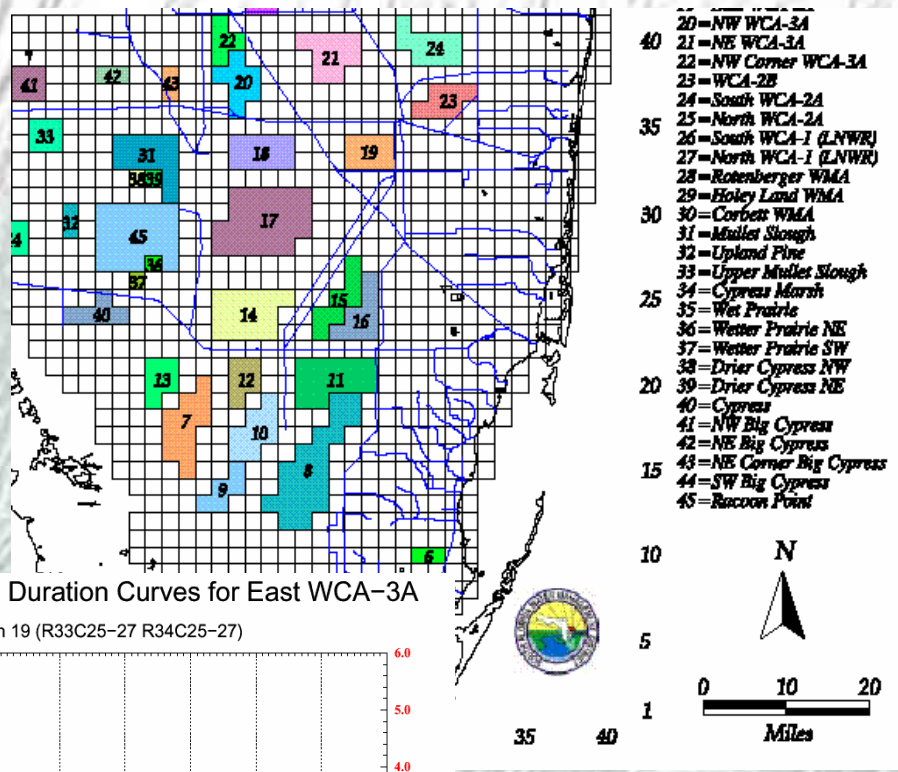
- **Number of Months Flow Does Not Meet Salinity Envelope Criteria**
  - High & Low Flows

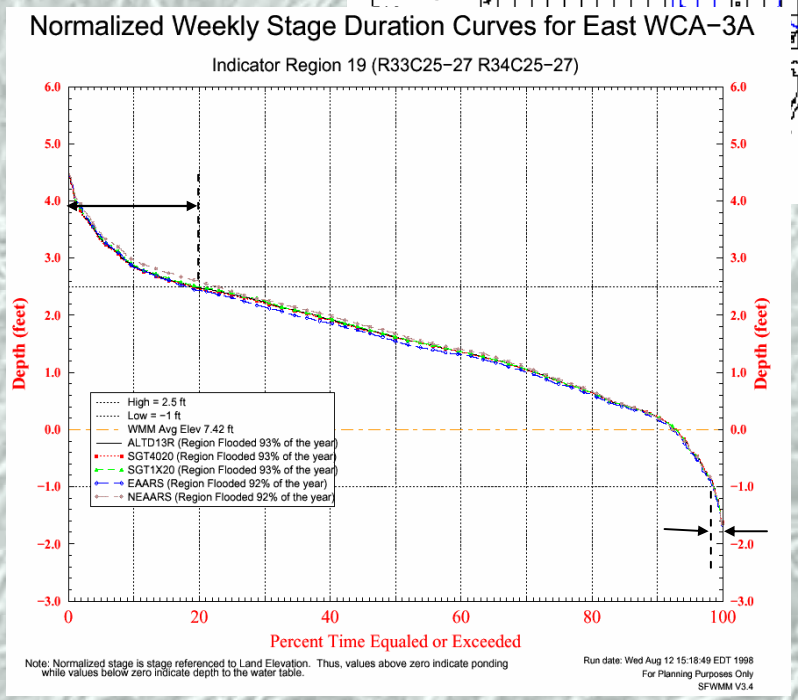


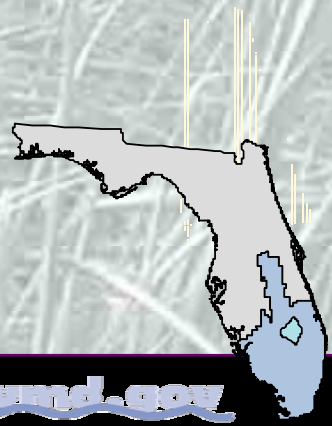
Hydrologic Performance Indicators

Water Conservation Areas (Indicator Regions)

- **Percent of Time Stages are Below the Low Threshold Criteria**
- **Percent of Time Stages are Above the High Threshold Criteria**



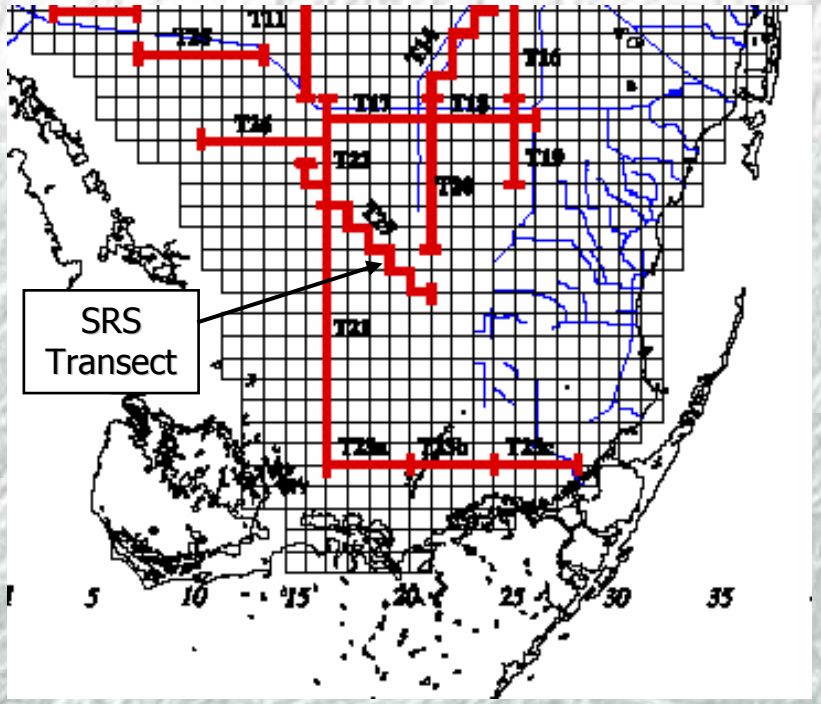


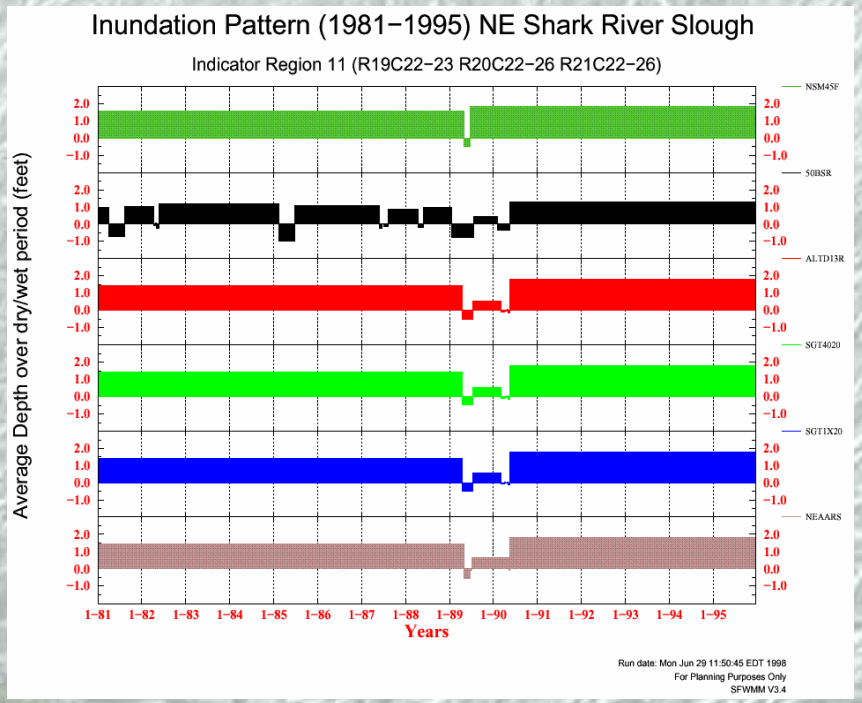


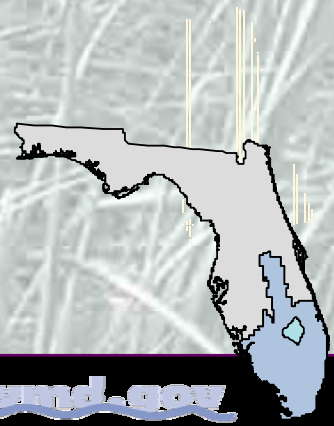
Hydrologic Performance Indicators

Everglades National Park

- **Mean Annual Flow Through Shark River Slough Diagonal Transect**
- **Number of Dryout Events in Northeast Shark River Slough (Indicator Region 11)**



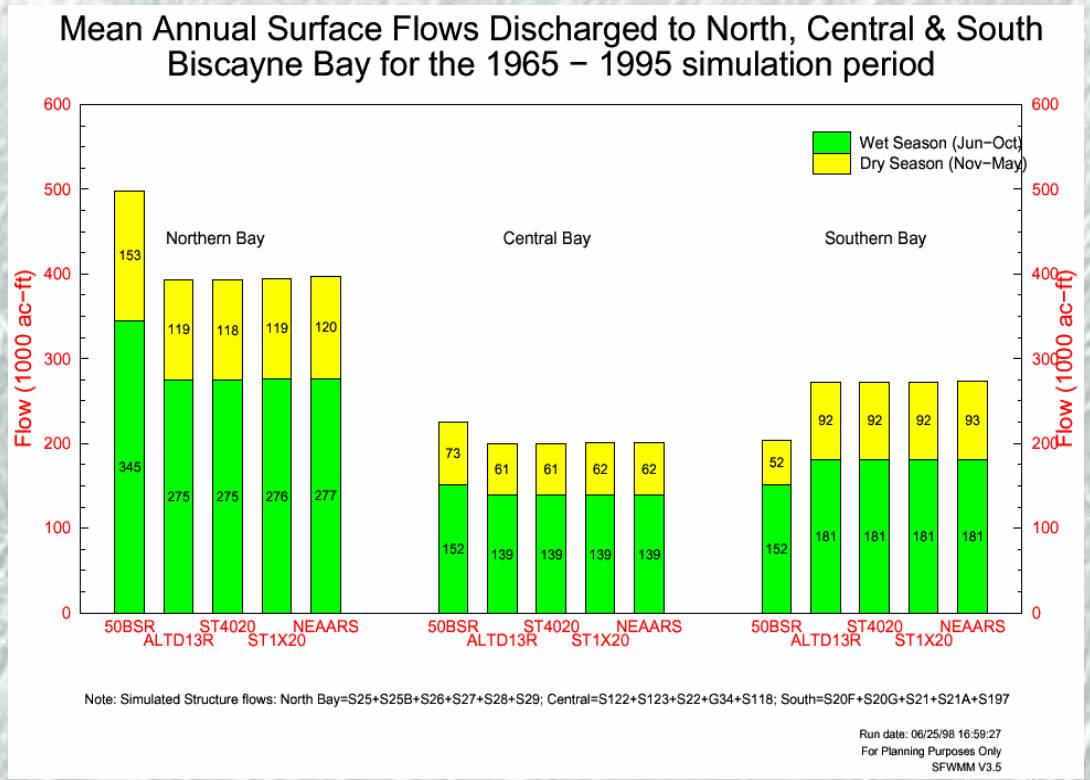




Hydrologic Performance Indicators

Biscayne Bay

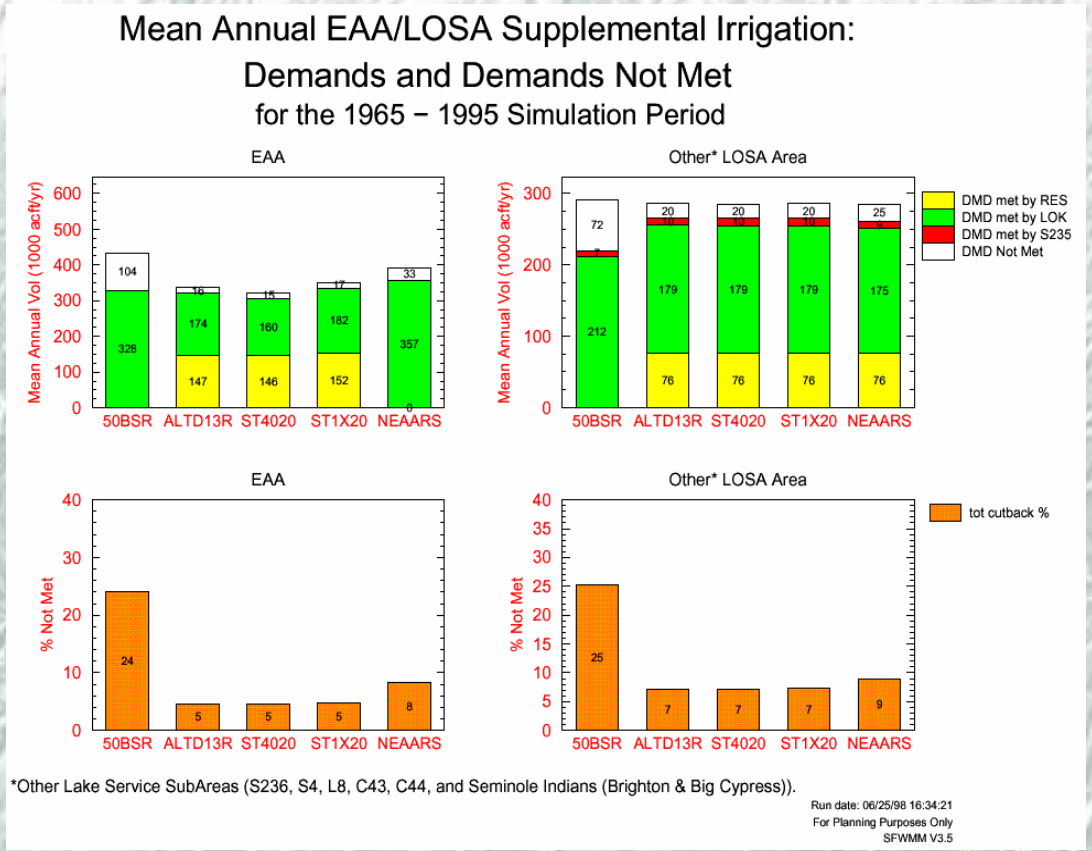
- **Mean Annual Flow Discharged into Biscayne Bay**
  - North Biscayne Bay
  - Central Biscayne Bay
  - South Biscayne Bay

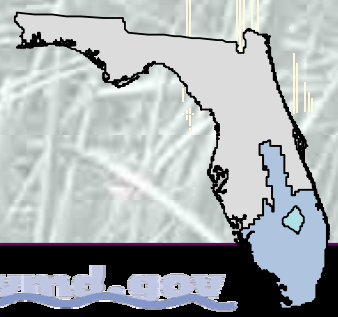


Hydrologic Performance Indicators

Water Supply

- **Lake Okeechobee Service Area**
  - Percent of Demands Not Met in Everglades Agricultural Area
  - Percent of Demands Not Met in Other Lake Okeechobee Service Area

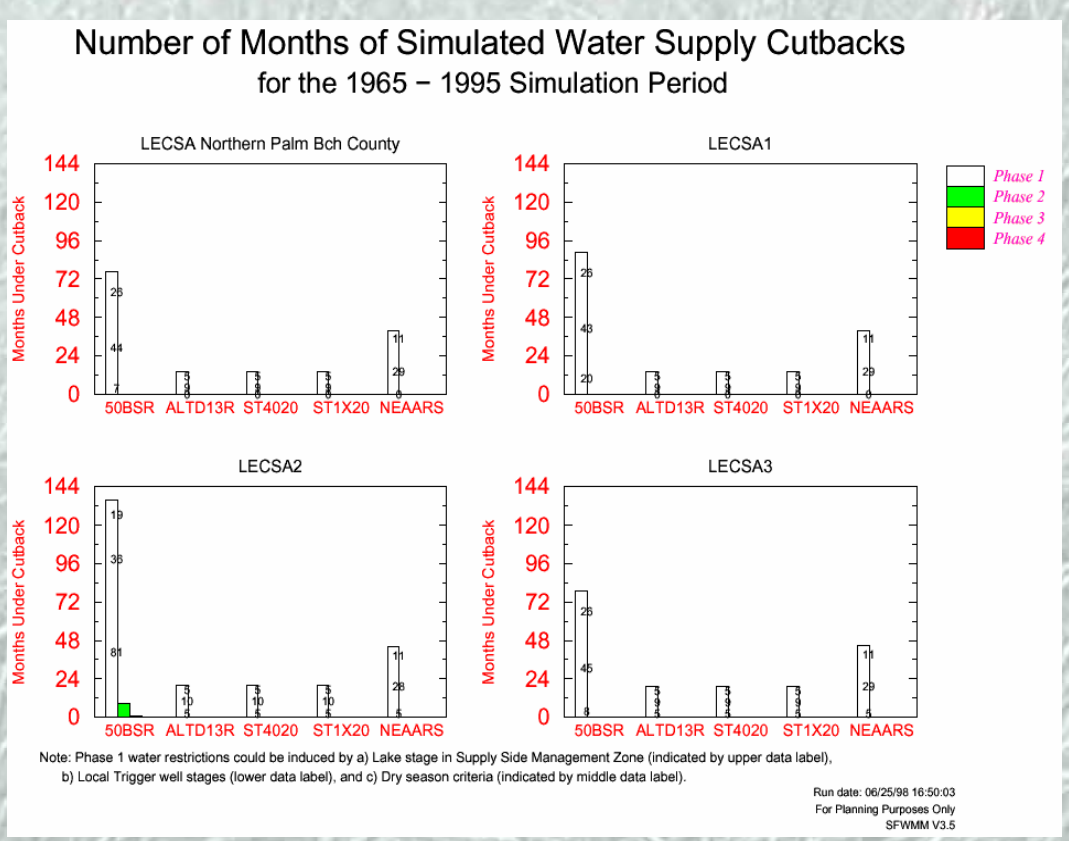


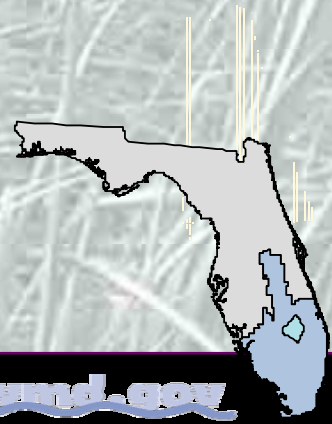


Hydrologic Performance Indicators

Water Supply

- **Lower East Coast Service Area**
  - Number of Months in Phase 1 Water Supply Cutbacks





Removal of Caloosahatchee ASR

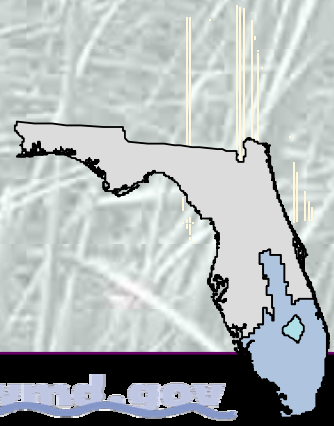
Lake Okeechobee	•
St. Lucie Estuary	---
Caloosahatchee Estuary	•
Water Conservation Area 1	---
Water Conservation Area 2A	---
Water Conservation Area 2B	---
Water Conservation Area 3A	---
Water Conservation Area 3B	---
Everglades National Park Shark River Slough	---
Biscayne Bay	---
Water Supply LOSA	---
Water Supply LECSA	---

Lake Okeechobee

→2% more time where lake is above 15' (20% vs 18%)

Caloosahatchee Estuary

→4 more months with undesirable low flows (40 vs 36)



Removal of Lake Okeechobee ASR

Lake Okeechobee	●
St. Lucie Estuary	●
Caloosahatchee Estuary	●
Water Conservation Area 1	---
Water Conservation Area 2A	---
Water Conservation Area 2B	---
Water Conservation Area 3A	●
Water Conservation Area 3B	●
Everglades National Park Shark River Slough	●
Biscayne Bay	---
Water Supply LOSA	●
Water Supply LECSA	●

Lake Okeechobee

→ 10% more time where lake is below 12′ (19% vs 9%)

→ 8% more time where lake is above 15′ (26% vs 18%)

St. Lucie Estuary

→ 7 more months with undesirable low flows (66 vs 59)

→ 4 more months with undesirable high flows (56 vs 52)

Caloosahatchee Estuary

→ 8 more months with undesirable high flows (19 vs 11)

Water Conservation Area 3A

→ 2% more time where IR19 stage is above 2.5′ (21 vs 19)

Water Conservation Area 3B

→ 2% more time where IR16 stage is above 2.5′ (7 vs 5)

Removal of Lake Okeechobee ASR (cont.)

Lake Okeechobee	●
St. Lucie Estuary	●
Caloosahatchee Estuary	●
Water Conservation Area 1	---
Water Conservation Area 2A	---
Water Conservation Area 2B	---
Water Conservation Area 3A	●
Water Conservation Area 3B	●
Everglades National Park Shark River Slough	●
Biscayne Bay	---
Water Supply LOSA	●
Water Supply LECSA	●

Everglades National Park (Shark River Slough)

→ 38,000 ac-ft more through SRS transect (1,148,000 vs 1,110,000)

Water Supply - LOSA

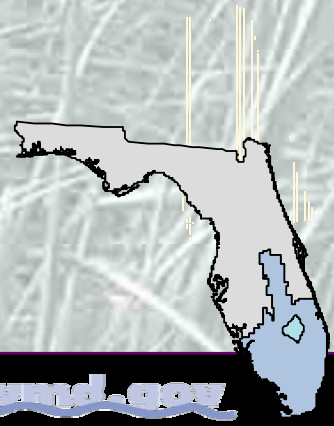
→ 5% more demands not met in EAA (10% vs 5%)

→ 5% more demands not met in other LOSA (12% vs 7%)

Water Supply - LECSA

→ 18 more months of cutbacks in NPB, SA1, and SA3 (32 vs 14 for NPB & SA1; 37 vs 19 for SA3)

→ 19 more months of cutbacks in SA2 (39 vs 20)

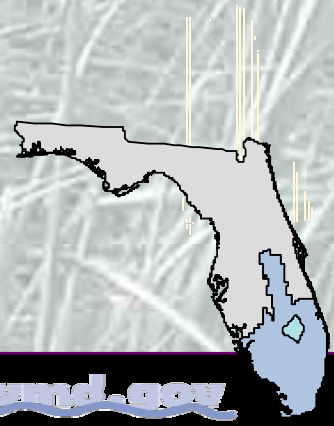


Removal of Lower East Coast ASRs

Lake Okeechobee	●
St. Lucie Estuary	---
Caloosahatchee Estuary	---
Water Conservation Area 1	---
Water Conservation Area 2A	---
Water Conservation Area 2B	---
Water Conservation Area 3A	---
Water Conservation Area 3B	---
Everglades National Park Shark River Slough	---
Biscayne Bay	---
Water Supply LOSA	---
Water Supply LECSA	---

Lake Okeechobee

→ 2% more time where lake is below 12' (11% vs 9%)

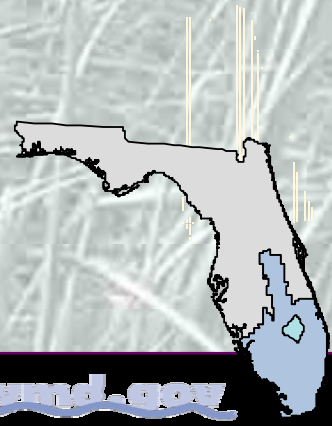


Doubling the Size of EAA Reservoir #2

Lake Okeechobee	●
St. Lucie Estuary	---
Caloosahatchee Estuary	---
Water Conservation Area 1	---
Water Conservation Area 2A	---
Water Conservation Area 2B	---
Water Conservation Area 3A	---
Water Conservation Area 3B	---
Everglades National Park Shark River Slough	---
Biscayne Bay	---
Water Supply LOSA	---
Water Supply LECSA	---

Lake Okeechobee

→ 1% less time where lake is above 15′ (17% vs 18%)

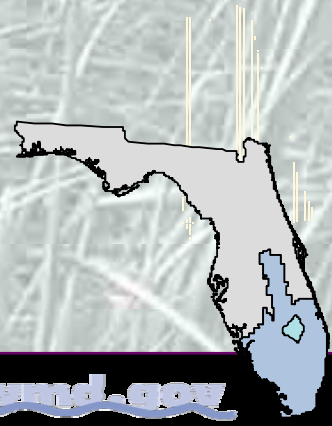


Removal of EAA Reservoir #3

Lake Okeechobee	●
St. Lucie Estuary	---
Caloosahatchee Estuary	---
Water Conservation Area 1	---
Water Conservation Area 2A	---
Water Conservation Area 2B	---
Water Conservation Area 3A	---
Water Conservation Area 3B	---
Everglades National Park Shark River Slough	---
Biscayne Bay	---
Water Supply LOSA	---
Water Supply LECSA	---

Lake Okeechobee

→ 2% more time where lake is below 12' (11% vs 9%)



Removal of EAA Reservoirs #2&3

Lake Okeechobee	●
St. Lucie Estuary	---
Caloosahatchee Estuary	---
Water Conservation Area 1	---
Water Conservation Area 2A	---
Water Conservation Area 2B	---
Water Conservation Area 3A	---
Water Conservation Area 3B	---
Everglades National Park Shark River Slough	●
Biscayne Bay	---
Water Supply LOSA	●
Water Supply LECSA	●

Lake Okeechobee

→ 1% less time where lake is below 12' (8% vs 9%)

→ 7% more time where lake is above 15' (25% vs 18%)

Everglades National Park (Shark River Slough)

→ 28,000 ac-ft less through SRS transect (1,082,000 vs 1,110,000)

Water Supply - LOSA

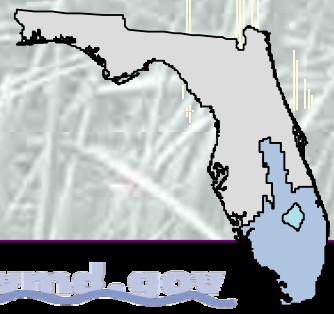
→ 2% less demands not met in EAA (3% vs 5%)

→ 1% less demands not met in other LOSA (6% vs 7%)

Water Supply - LECSA

→ 7 fewer months of cutbacks in NPB, SA1, and SA3 (7 vs 14 for NPB & SA1; 12 vs 19 for SA3)

→ 6 fewer months of cutbacks in SA2 (14 vs 20)



Removal of All EAA Reservoirs

Lake Okeechobee	●
St. Lucie Estuary	---
Caloosahatchee Estuary	---
Water Conservation Area 1	---
Water Conservation Area 2A	---
Water Conservation Area 2B	---
Water Conservation Area 3A	●
Water Conservation Area 3B	●
Everglades National Park Shark River Slough	●
Biscayne Bay	---
Water Supply LOSA	●
Water Supply LECSA	●

Lake Okeechobee

→ 5% more time where lake is below 12′ (14% vs 9%)

→ 2% more time where lake is above 15′ (20% vs 18%)

Water Conservation Area 3A

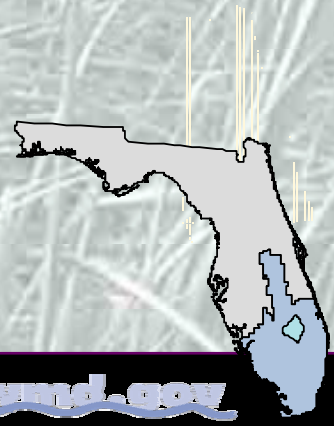
→ 4% more time where IR19 stage is above 2.5′ (23 vs 19)

Water Conservation Area 3B

→ 2% more time where IR16 stage is above 2.5′ (7 vs 5)

Everglades National Park (Shark River Slough)

→ 61,000 ac-ft more through SRS transect (1,171,000 vs 1,110,000)



Removal of All EAA Reservoirs (cont.)

Lake Okeechobee	●
St. Lucie Estuary	---
Caloosahatchee Estuary	---
Water Conservation Area 1	---
Water Conservation Area 2A	---
Water Conservation Area 2B	---
Water Conservation Area 3A	●
Water Conservation Area 3B	●
Everglades National Park Shark River Slough	●
Biscayne Bay	---
Water Supply LOSA	●
Water Supply LECSA	●

Water Supply - LOSA

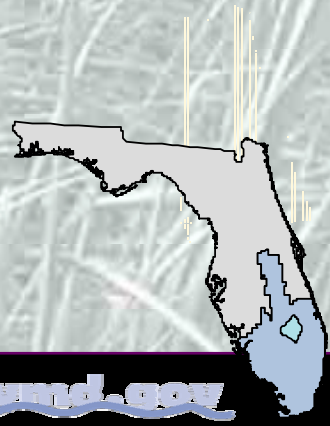
→ 3% more demands not met in EAA (8% vs 5%)

→ 2% more demands not met in other LOSA (9% vs 7%)

Water Supply - LECSA

→ 26 more months of cutbacks in NPB, SA1, and SA3 (40 vs 14 for NPB & SA1; 45 vs 19 for SA3)

→ 24 more months of cutbacks in SA2 (44 vs 20)



Removal of Central Lake Belt Reservoir

Lake Okeechobee	---
St. Lucie Estuary	---
Caloosahatchee Estuary	---
Water Conservation Area 1	---
Water Conservation Area 2A	---
Water Conservation Area 2B	---
Water Conservation Area 3A	---
Water Conservation Area 3B	●
Everglades National Park Shark River Slough	●
Biscayne Bay	●
Water Supply LOSA	---
Water Supply LECSA	---

Water Conservation Area 3B

→ 1% more time where IR16 stage is below -1.0' (2 vs 1)

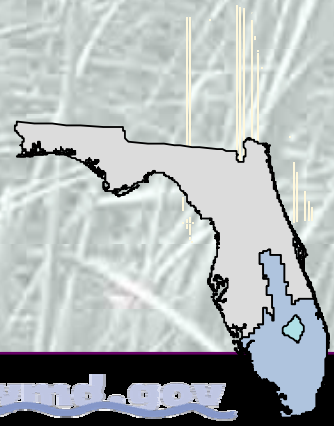
Everglades National Park (Shark River Slough)

→ 45,000 ac-ft less through SRS transect (1,065,000 vs 1,110,000)

→ 7 more dryouts in IR11 (11 vs 4)

Biscayne Bay

→ 84,000 ac-ft more flow discharged into Biscayne Bay (951,000 vs 867,000)



Removal of North Lake Belt Reservoir

Lake Okeechobee	●
St. Lucie Estuary	---
Caloosahatchee Estuary	---
Water Conservation Area 1	---
Water Conservation Area 2A	---
Water Conservation Area 2B	---
Water Conservation Area 3A	---
Water Conservation Area 3B	●
Everglades National Park Shark River Slough	●
Biscayne Bay	●
Water Supply LOSA	---
Water Supply LECSA	●

Lake Okeechobee

→ 4% more time where lake is below 12' (13% vs 9%)

Water Conservation Area 3B

→ 2% more time where IR16 stage is above 2.5' (7 vs 5)

Everglades National Park (Shark River Slough)

→ 38,000 ac-ft more through SRS transect (1,148,000 vs 1,110,000)

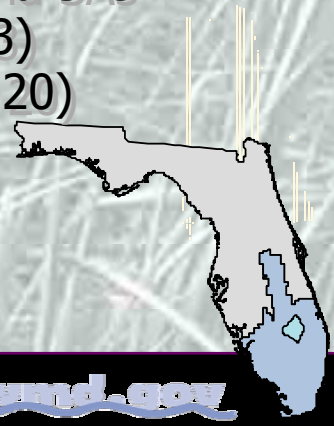
Biscayne Bay

→ 62,000 ac-ft less flow discharged into Central Biscayne Bay (138,000 vs 200,000)

Water Supply - LECSA

→ 5 more months of cutbacks in NPB, SA1, and SA3 (19 vs 14 for NPB & SA1; 24 vs 19 for SA3)

→ 19 more months of cutbacks in SA2 (39 vs 20)



Removal of South Miami-Dade Reuse Water

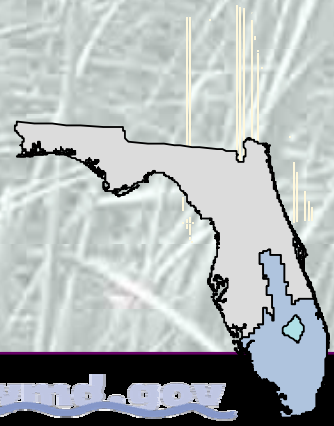
Lake Okeechobee	---
St. Lucie Estuary	---
Caloosahatchee Estuary	---
Water Conservation Area 1	---
Water Conservation Area 2A	---
Water Conservation Area 2B	---
Water Conservation Area 3A	---
Water Conservation Area 3B	---
Everglades National Park Shark River Slough	---
Biscayne Bay	●
Water Supply LOSA	---
Water Supply LECSA	●

Biscayne Bay

→ 119,000 ac-ft less flow discharged into Biscayne Bay (748,000 vs 867,000)

Water Supply - LECSA

→ 10 more months of cutbacks in SA3 (29 vs 19)



Removal of West Miami-Dade Reuse Water

Lake Okeechobee	●
St. Lucie Estuary	---
Caloosahatchee Estuary	---
Water Conservation Area 1	---
Water Conservation Area 2A	---
Water Conservation Area 2B	---
Water Conservation Area 3A	---
Water Conservation Area 3B	---
Everglades National Park Shark River Slough	●
Biscayne Bay	●
Water Supply LOSA	---
Water Supply LECSA	●

Lake Okeechobee

→ 4% more time where lake is below 12' (13% vs 9%)

Everglades National Park (Shark River Slough)

→ 42,000 ac-ft less through SRS transect (1,068,000 vs 1,110,000)

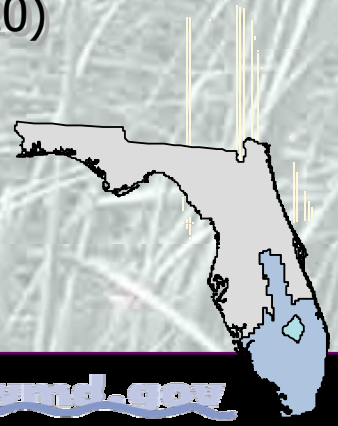
Biscayne Bay

→ 20,000 ac-ft less flow discharged into Biscayne Bay (847,000 vs 867,000)

Water Supply - LECSA

→ 5 more months of cutbacks in NPB, SA1, and SA3 (19 vs 14 for NPB & SA1; 24 vs 19 for SA3)

→ 6 more months of cutbacks in SA2 (26 vs 20)



Summary of Sensitivity Study

	No Caloos. ASR	No Lake ASR	No LEC ASR	EAA Res. #2 x 2	No EAA Res. #3	No EAA Res. #2,3	No EAA Reservoirs	No Central Lkblt.	No North Lkblt.	No S.Dade Reuse	No W.Dade Reuse
Lake Okeechobee	●	●	●	●	●	●	●	---	●	---	●
St. Lucie Estuary	---	●	---	---	---	---	---	---	---	---	---
Caloosahatchee Estuary	●	●	---	---	---	---	---	---	---	---	---
Water Conservation Area 1	---	---	---	---	---	---	---	---	---	---	---
Water Conservation Area 2A	---	---	---	---	---	---	---	---	---	---	---
Water Conservation Area 2B	---	---	---	---	---	---	---	---	---	---	---
Water Conservation Area 3A	---	●	---	---	---	---	●	---	---	---	---
Water Conservation Area 3B	---	●	---	---	---	---	●	●	●	---	---
Everglades National Park Shark River Slough	---	●	---	---	---	●	●	●	●	---	●
Biscayne Bay	---	---	---	---	---	---	---	●	●	●	●
Water Supply LOSA	---	●	---	---	---	●	●	---	---	---	---
Water Supply LECSA	---	●	---	---	---	●	●	---	●	●	●